

NON-PUBLIC?: N
ACCESSION #: 8804130113
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Kewaunee Nuclear Power Plant PAGE: 1 of 5

DOCKET NUMBER: 05000305

TITLE: Insulation Failure and Dirt Accumulation Cause Electrical Bus Bar
Failure and Reactor Trip
EVENT DATE: 03/02/88 LER #: 88-001-00 REPORT DATE: 04/04/88

OPERATING MODE: N POWER LEVEL: 093

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Jeffrey W. Bergmann - Engineer TELEPHONE #: 414-388-2560

COMPONENT FAILURE DESCRIPTION:
CAUSE: C SYSTEM: EA COMPONENT: NSBU MANUFACTURER: C048
REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: At 1348 on March 2, 1988, with the plant at 93.3% power due to the end of life coastdown prior to the annual refueling outage, a reactor/turbine trip occurred due to an undervoltage (UV) condition on 4160 volt electrical buses 1-1 and 1-2. These buses supply power to the reactor coolant pumps (RXCP) and the main feedwater pumps (FWP).

During normal power operation, the main auxiliary transformer (MAT) supplies power to the 4160 volt buses 1-1 and 1-2 from its "Y" windings. A section of the bus bar running from the MAT to the bus switchgear was badly damaged due to insulation failure and a subsequent fault. The fault on the bus bar caused an undervoltage condition of less than 77% of rated voltage on buses 1-1 and 1-2, resulting in a reactor trip. The reserve auxiliary transformer (RAT) assumed the loads for buses 1-1 and 1-2. Based on the amount of smoke present in the turbine building the Shift Supervisor activated the plant's emergency siren which required all on-site personnel to assemble for accountability. The differential current protection functioned as designed and opened all breakers on the affected protection zone. This de-energized the affected bus and terminated the fire. The fire team was dispatched to control the situation. Immediately after the trip, operators implemented the

appropriate Operating Procedures and stabilized the plant at hot shutdown. Plant systems performed as designed.

The plant then entered its scheduled refueling shutdown. Corrective actions included a complete investigation by the manufacturer of the bus bars, a private consultant, and an independent laboratory. They will provide an independent analysis of the failure. The damaged section of the bus bar and the insulation on the entire bus from the MAT to the bus 1-1 and 1-2 switchgear will be replaced during the refueling outage with a different type insulation.

(End of Abstract)

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Description of Event

At 1348 on March 2, 1988, with the plant at 93.3% power due to the end of life coastdown prior to the annual refueling outage, a reactor/turbine trip occurred due to an undervoltage (UV) transient on two 4160 volt electrical buses (NSBU), 1-1 and 1-2. Buses 1-1 and 1-2 supply power to the reactor coolant pump (RXCP) (AB) and the main feedwater pump (FWP) (SJ) motors.

At 1348, the main auxiliary transformer (MAT) (RL) differential current alarm annunciated in the control room and smoke was reported in the turbine building basement. Based on the amount of smoke present in the turbine building the Shift Supervisor activated the plant's emergency siren which required all on-site personnel to assemble for accountability. The differential current protection functioned as designed and opened all breakers on the affected protection zone. This de-energized the affected bus and terminated the fire. The fire team was dispatched to control the situation. The plant then entered its scheduled refueling outage two days earlier than planned.

During normal power operation the main auxiliary transformer (MAT) (EL) fed by the main generator (TB), supplies power to the 4160 volt electrical buses 1-1 and 1-2 from its "Y" windings and 4160 volt electrical buses 1-3 and 1-4 from its "X" windings. A failure of the bus bar to buses 1-3 and 1-4 in July 1987 (LER 87-9), resulted in supply to bus 1-3 and 1-4 to be transferred to the reserve auxiliary transformer (RAT) (EL) for the remainder of the fuel cycle. Safeguards buses 1-5 and 1-6, although capable of being powered by the MAT, were supplied from offsite power via the tertiary auxiliary transformer (TAT) (EL) and the (RAT), respectively.

A fault, due to insulation failure, occurred on the bus bar routed from the main auxiliary transformer to buses 1-1 and 1-2. The bus bar is 1/2 inch by 4 inch flat copper bar, with a tin finish at the joints, rated at 4000 amps per

phase and is manufactured by the Calvert Company (C048). The bus bar is encapsulated with Noryl insulation.

The fault on the bus caused the voltage at the switchgear to decrease. The coincident undervoltage on both buses caused a reactor trip and subsequent turbine trip. The bus undervoltage reactor trip is set at 77% of the rated bus voltage for greater than 0.1 second. This caused the source breakers from the MAT to the switchgear to open.

The operators performed the recovery actions specified in the Emergency Operating Procedure E-O, "Reactor Trip or Safety Injection", and proceeded to bring the reactor to the hot shutdown condition. A post trip review was performed to determine the trip initiating signal and safety significance.

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During and after the trip, all safety systems performed as designed. Main feedwater was isolated and the Auxiliary Feedwater System (BA) was automatically initiated to provide the necessary secondary heat removal. Both Diesel Generators 1A and 1B started as required on a turbine trip.

Buses 1-1 and 1-2 were automatically isolated from the Main Auxiliary Transformer and transferred to the Reserve Auxiliary Transformer. This fast transfer prevented the Reactor Coolant Pumps (RXCP) and the main feedwater pumps (FWP) from tripping on the UV condition due to a time delay in the pumps' breaker trip logic.

Cause of Event

The root cause of the event was an insulation failure on the Bus Bar at the Bus Bar support combined with the accumulation of debris and water. The Bus Bar runs horizontally into the Auxiliary Building underneath various areas where debris can fall into the bus work. Above the faulted section of bus bar, a plastic hose which was designed to empty into a floor drain, was emptying on the floor and it is suspected that water may have dripped onto the buswork. The insulation failure combined with the accumulated dirt and water provided a tracking path for the fault.

Analysis of Event

This event is being reported per 50.73(a)(2)(iv) as an actuation of the Reactor Protection System (RPS) and actuation of Engineered Safety Features (ESF) (JE). The undervoltage signal on buses 1-1 and 1-2 is provided to trip the reactor to prevent the loss of forced circulation through the core under full power conditions. Undervoltage conditions (for greater than .1 second) from both electrical buses 1-1 and 1-2, which

supply power to the Reactor Coolant Pumps, initiates the reactor trip. A time delay relay of 5 seconds is designed in the RXCP logic to prevent the tripping of the pumps before fast transfer to an off-site power supply. The Reactor Coolant Pumps, as designed, transferred to the RAT and continued to operate and supply forced coolant circulation through the core. Since the Auxiliary Feedwater Pumps were also operating as designed, decay heat continued to be removed from the core and there was no impact on the health and safety of the public.

Damage to equipment was limited to a 10 foot section of the bus-bar from the MAT to buses 1-1 and 1-2. In addition insulation between the insulated bus bar supports experienced some cracking due to the force of the fault. The related fire was terminated by the deenergizing of the bus. Several non-safety related cables located in a cable tray adjacent to the bus experienced insulation failure as a result of this event. There was no personnel injuries experienced during the event.

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The bus bar from the main auxiliary transformer to buses 1-1 and 1-2 was isolated and inspected for damage during the refueling outage. Presently, the reserve auxiliary transformer feeds Bus 1-3, 1-4 and 1-6 and the tertiary auxiliary transformer feeds Bus 1-5. Buses 1-1 and 1-2 are not required for this plant condition.

Corrective Actions

The following corrective actions have been initiated:

A. Immediate Action

1. The damaged section of Bus Bar was immediately isolated. The bus bar and main auxiliary transformer were inspected to determine the extent of damage. Safeguards buses 1-5 and 1-6 remained in their normal line-up supplied by the TAT and RAT.

B. Long Term Actions

1. The bus bar vendor, a consultant, and an independent laboratory will provide an analysis of the insulation breakdown and recommended corrective actions.
2. The damaged section of the bus bar will be replaced during the current Refueling Outage.

3. Maintenance is continuing the inspection and cleaning of all the bus bar runs and ducting, as recommended in LER 87-9.

4. A design change request has been initiated to suspend a protective cover over portions of the bus duct. This plate should prevent debris and fluids from coming into contact with the bus bar insulation from above.

5. A design change request has been initiated to change insulation on the bus bar feeding Bus 1-1 and 1-2 from the MAT to a heat shrink type during the current Refueling Outage.

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Additional Information

Similar Events

1. On January 5, 1980 a ground fault failure and subsequent bus bar connector failed on the "Y" windings of the main auxiliary transformer. This caused a reactor trip, and turbine trip. The damaged bus bar was replaced and the remaining bus bar was inspected.

2. On January 17, 1980, due to a blown bushing on the reserve auxiliary transformer, a phase to phase differential lockout occurred. This caused a reactor trip and turbine trip. The damaged bus work was investigated and repaired.

3. On August 20, 1980 a short occurred on the bus work from the RAT to buses 1-1 and 1-2. This caused a reactor trip and turbine trip. The damaged section of the bus was replaced and the remaining bus bar was inspected.

4. On July 10, 1987 (LER 87-9) a ground fault occurred due to insulation failure on the bus bars from the "X" windings of the MAT. This caused a reactor trip and turbine trip. The damaged bus bar section was replaced and the remaining "X" winding bus bar was inspected.

Equipment Failure

The bus bar was supplied by The Calvert Company. The bus bar is 1/2 by 4 inch flat copper bar, full round edge, and rated at 4000 amps per phase. All three phases of the bus work were insulated with Noryl flame retardant insulation, and supported on molded flame retardant glass polyester supports. The bus work is enclosed in an aluminum ducting with ventilated slots on the top and bottom. Screens are also located between the slots and bus bars in various areas.

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April 4, 1988 10 CFR 50.73

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 88-001-00

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report for reportable occurrence 88-001-00 is being submitted.

Sincerely,
/s/ D. Hintz
D. C. Hintz
Vice President - Nuclear Power

TJW/jms
Attach.
cc - INPO Records Center
Mr. Robert Nelson
US NRC, Region III

*** END OF DOCUMENT ***
